

What is claimed is:

1. A multiple beam linear accelerator system, comprising:  
at least two linear accelerator waveguides, the at least two linear accelerator waveguides tuned to different resonant frequencies spaced apart to allow only one of  
5 the at least two linear accelerator waveguides to accept a given high power radio frequency (RF) pulse;  
an RF generator, including an RF power device, for providing high power RF pulses alternately at the different resonant frequencies; and  
a modulator for providing high voltage pulses to the RF power device in  
10 synchronization with the RF signals.
2. The multiple beam linear accelerator system of claim 1, wherein the RF signals are microwave signals.
3. The multiple beam linear accelerator system of claim 2, wherein the different frequencies are spaced apart by at least a minimum separation required to allow  
15 power to be directed to one accelerator at a time.
4. The multiple beam linear accelerator system of claim 3, wherein the minimum separation is approximately 1.0 MHz.
5. The multiple beam linear accelerator system of claim 1, further including a circulator system for directing the high power RF pulses.
- 20 6. The multiple beam linear accelerator system of claim 5, wherein the circulator system is a multi-port circulator.
7. The multiple beam linear accelerator system of claim 1, further including a high voltage power supply for supplying addressed high voltage inputs to the modulator in accordance with the different resonant frequencies.

8. The multiple beam linear accelerator system of claim 1, wherein the RF power device is a klystron and the RF generator includes an RF driver.
9. The multiple beam linear accelerator system of claim 1, further including a control signal multiplexer for determining an RF input signal to provide to the RF driver.
10. The multiple beam linear accelerator system of claim 1, further including a control system for synchronizing the RF signals and high voltage inputs to the modulator, and for triggering the high voltage RF pulses to the RF power device.
11. A high power radio frequency (RF) pulse supply system for a multiple beam linear accelerator having a plurality of linear accelerator waveguides, comprising:  
an RF generator, including an RF power device, for providing high power RF pulses in sequence at differing frequencies corresponding to resonant frequencies of the plurality of linear accelerator waveguides, the resonant frequencies chosen such that substantially only one of the plurality of linear accelerator waveguides accepts high power RF pulses at each differing frequency; and  
a modulator for providing high voltage pulses to the RF power device in synchronization with the RF signals.
12. The high power RF pulse supply system of claim 11, wherein the RF signals are microwave signals.
13. The high power RF pulse supply system of claim 11, further including a network of circulators for directing the high power RF pulse to one of the plurality of linear accelerator waveguides.
14. The high power RF pulse supply system of claim 11, further including a high voltage power supply for supplying addressed high voltage inputs to the modulator in accordance with the differing frequencies.

15. The high power RF pulse supply system of claim 11, wherein the RF power device is a klystron, and the RF generator further includes an RF driver.
16. The high power RF pulse supply system of claim 15, further including a multiplexer for determining a control signal to provide to the RF driver.
- 5 17. The high power RF pulse supply system of claim 11, further including a control system for synchronizing the RF signals and high voltage inputs to the modulator, and for triggering the high voltage RF pulses from the RF power device.
18. A method for controlling a single RF power device to supply a plurality of linear accelerator waveguides in a multiple beam linear accelerator, comprising the steps
- 10 of:
- (i) generating an RF signal having a frequency corresponding to a resonant frequency of one of the plurality of linear accelerator waveguides;
  - (ii) generating a high power RF pulse at the frequency;
  - (iii) directing the high power RF pulse to one of the plurality of linear
- 15 accelerator waveguides having a resonant frequency corresponding to the frequency; and
- (iv) repeating steps (i) to (iii) on a pulse-by-pulse basis to alternate between different frequencies corresponding to resonant frequencies of the plurality of linear
- 20 accelerator waveguides, the resonant frequency of each of the plurality of linear accelerator waveguides chosen such that only one of the plurality of linear accelerator waveguides accepts a pulse generated at a given frequency.
19. The method of claim 18, wherein the step of providing the RF signal includes multiplexing between a plurality of RF signals.
20. The method of claim 18, wherein the step of providing the high power RF
- 25 pulse includes multiplexing between a plurality of high voltage control inputs.

21. The method of claim 18, further including tapping pulses for any of automatic frequency control, beam monitoring, and forward and reflected power monitoring.